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COVER

An H-13 towing a water skier was one of many demonstrations of Army Aviation's versatility during the air show which highlighted Army Aviation's 15th anniversary celebration at Fort Rucker, Ala., June 5-7. An aviation symposium, sponsored by the Association of the United States Army, was also featured.

Notes

FROM THE PENTAGON

Major General Hamilton H. Howze, *USA*
Director of Army Aviation, ODCSOPS

THE USE OF THE HELICOPTER AS A RECONNAISSANCE VEHICLE

A TRIP TO THE LIBRARY will convince you that the use of an aircraft as a reconnaissance vehicle is not a new idea. The helicopter in that role is just another example of bringing an old idea up to date. To bear out this point I would like to quote from "Modern Cavalry" by Major Malcohn Wheeler-Nicholson, Cavalry, United States Army, published in 1922.

"In line with a great many hasty judgments, the aeroplane has been slated to supplant cavalry in the field of reconnaissance. . . . One of the first effects of the appearance of any new type of fighting machine or of any new method of warfare, is the claim made by its partisans and taken up immediately by journalistic laymen that the innovation would supplant all previous measures anywhere remotely allied to its function. . . .

"The following are some of the factors that militate against successful air reconnaissance or that will militate against it in future wars.

"a. Hostile control of the air.

"b. Unfavorable weather conditions.

"c. Present and future possibilities of antiaircraft defense.

"d. Present and future possibilities of concealment and camouflage for troops.

"e. Night operations.

"f. Inability of the aeroplane to take prisoners, examine dead and wounded, judge enemy morale, etc.

"g. Lack of continuity of observation."

Not bad, Major Wheeler-Nicholson.

My purpose is not to prove the helicopter a complete substitute

for the horse, the jeep, the truck, the tank or what have you—but rather to point out its tremendous value when used *in conjunction* with those devices. The helicopter can give our reconnaissance a tremendous shot in the arm.

Let's have a look at how the unique agility and abilities of the helicopter can overcome the limitations predicted by Major W.-N.:

(1) Enemy Air Superiority: This naturally will have considerable influence on the use of our aircraft in the performance of any function. However, techniques of operating the helicopter close to the ground at treetop level can minimize the effect of enemy air superiority or the enemy's control of the air by other means.

(2) Bad Weather: In the 35 years since Major Wheeler-Nicholson's forecast, much has been done to attain all-weather capability, and much is in prospect in the near future. But weather does indeed remain a restricting factor; however, the same can be said for *any* means of reconnaissance. In some conditions the aircraft is better off than ground vehicles.

(3) Enemy Antiaircraft Measures: Although much has been said about the inability of the helicopter to survive against small arms fire while flying over enemy held territory, the truth is the helicopter should suffer no greater hazard than the ground vehicle provided it remains close to the ground. How many times has a jeep on a reconnaissance mission been called upon to drive deliberately and directly *into* an enemy position? And if it did this very foolish act, how often would it return unharmed? The point is that there is no reason to expect the helicopter employed in a reconnaissance role to have any magic formula for survival when *improperly* employed; it is not intended that helicopter pilots on a reconnaissance mission become dead heroes. A commander assigning missions to his helicopter-equipped reconnaissance force should not expect this force to penetrate into enemy territory to gain information, but rather to perform a reconnaissance of the *fringes* of enemy territory faster and better than can be done by surface vehicles alone.

(4) Night Operations: The helicopter itself is already capable of being operated at night quite successfully. Admittedly, it requires some improvements in instrumentation but its potentialities are tremendous because of its unique ability to hover. To be sure—night reconnaissance from a helicopter is still difficult, but it may become fairly routine if we manage to gain 20-20 electronic night vision.

(5) Inability to Take Prisoners, Examine Dead and Wounded, or Judge Enemy Morale: This has been a disadvantage of the fixed-wing airplane, but it doesn't fully apply to the helicopter. This amazing machine with its ability to land on and

take off from almost any place can accomplish with aplomb and dexterity most of the feats which the Major reserved for the horse.

(6) Lack of Continuity of Observation: Much has already been accomplished in this regard; the ability to operate at night and during conditions of poor visibility already has been greatly improved. But at the *present* stage of the game, W.-N. stands uncontradicted; at the current pace of new developments in the field of electronics, however, 24-hour around-the-clock operation should, in a few years, become much more commonplace.

In a nutshell, the helicopter's abilities to land and take off vertically, to hover, to fly right, left and backwards, and to fly close to the ground, overcome most of the fixed-wing limitations which looked so serious to the very sensible Major.

When one contemplates the mobility now characteristic of all tactical units in modern armies, it becomes fairly obvious that a new approach is mandatory for the reconnaissance mission. You can undoubtedly recall numerous occasions when fairly powerful reconnaissance units sat motionless and frustrated in a defile because the road ahead was blocked by a blown crater, culvert or bridge, a mined road or a muddy field—or one or two impossible-to-locate snipers who shot holes through the heads of the unwary. Had you been in a helicopter, these obstacles would have been no more than bits of reconnaissance information to be passed on to higher headquarters.

With the provision of a limited number of helicopters in the aviation companies for the specific purpose of serving the reconnaissance battalion, we have taken the first steps to lift our cavalrymen from the ground. But we urgently need to exercise our imagination and wits to really exploit the potential of light aircraft. Thus must we restore the necessary "mobility differential" to reconnaissance units.

Lt John E. Armstrong, TC

IN THE WAY that cavalry units of the pretank era were limited by what the horse could do, performance of Army helicopters is restricted by limitations of the vehicle.

Recognizing this drawback, the Army has let, through its research program, a series of contracts to various aircraft manufacturers to develop the concepts of Vertical Take Off and Landing aircraft.

With realization of a practical type VTOL aircraft, the Army is in effect developing a new type of "steed" tailored to today's logistical and tactical needs. This aircraft, having vertical takeoff and landing capabilities and a considerable operational radius, should contain the element of surprise because of its speed. This speed also enables troops to be moved with greater safety by decreasing the time it

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is subjected to enemy fire and provides for more round trips per vehicle in any given period.

Out of these new concepts, the Army hopes to realize its ultimate goal of an aircraft that has the landing and hovering capabilities of the helicopter, teamed with the speed and inflight stability of the fixed-wing airplane. While this idea is not new to the field of aeronautics, until the past few years the state of aerodynamic art and powerplant development has been unable to provide a sound workable basis for this concept.

Principally, all VTOL designs strive for an aircraft that will take off vertically or with an extremely short ground run, yet fly at fast forward speeds. Although widespread disagreement prevails among aeronautical experts as to the finalized form of the future VTOL aircraft, they agree that the most urgent requirement is for flight experience with designs embodying the new principles. Their disagreement primarily concerns the designs necessary to achieve dual flight functions.

The Army, Navy, and Air Force have financed over 15 different projects involving construction and testing of VTOL prototypes and testbeds. These basic designs generally follow the principles of the tilt-rotor, tilt-wing, gyrodyne, deflected slip stream, ducted fan, and the "pogo" or tail sitter type aircraft.

The helicopter, first VTOL aircraft, is considered the most efficient from the standpoint of pure vertical lift, since it will develop 12 to 15 pounds of static thrust per horsepower. Aircraft

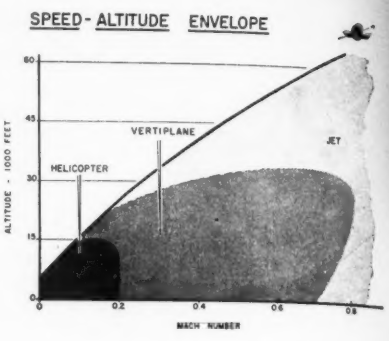


Figure 1

embodying oversized propellers to develop VTOL capabilities yield three to five pounds of static thrust per horsepower, and the "pogo" or tail sitter is considered least efficient, with less than a one to one ratio.

Although this gives the helicopter a decided advantage in vertical lift, its limitations in forward speeds and high maintenance costs have caused the services to search for a more versatile vehicle. Furthermore, the forward speed of the helicopter is limited by retreating blade stall and the advancing blade approaching the sonic barrier, which makes speeds of 200 miles an hour doubtful for this type aircraft.

The chart shown in Figure 1 illustrates the need for VTOL progress and the comparative stalemate in helicopter design.

GYRODYNE

Two aircraft corporations are pioneering in the use of the gyrodyne concept. The Fairey Aviation Company, Ltd., of England, and the McDonnell Aircraft Corporation of St. Louis, are engaged in development of a large powered rotor for primary ver-

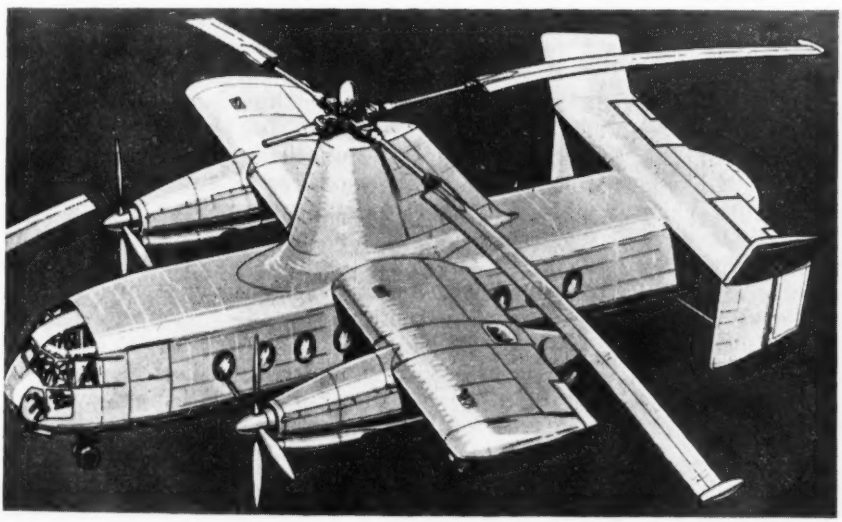
McDonnell XV-1 test flights started in 1955.

tical lift. When adequate forward speeds are reached, a short stubby wing provides the lift and conventional propellers provide thrust. While hovering, small jet engines mounted on the tips of the rotor blades provide rotor power. After takeoff when forward speed is attained, the jet engines are cut and collective pitch adjusted to unload the rotor, which is allowed to "windmill" during the conventional flight. No transmission is needed in this design and there is no torque reaction while hovering.

The Fairey "Rotodyne" is a cargo version of this principle. It is powered by two gas turbine engines, each of which drives a propeller directly and an auxiliary compressor through a clutch mechanism. In hovering flight, compressed air is pumped through ducts to the rotor head and then through the blades to the jet units. When operating height has been attained and forward speed increased, still operating as a helicopter, the propeller pitch is increased to give forward thrust. The clutch is disengaged, allowing the rotor to become "free wheeling." On the approach to land, this transition is reversed.

The McDonnell XV-1, a project financed jointly by the Army and the Air Force, is an experimental liaison and research con-

Fairey Rotodyne is powered by two gas turbine engines.



Bell XV-3 employs tilt-rotor principle.

vertiplane. It employs generally the same system as the "Rotodyne." Actual flight tests on this aircraft started in 1955.

TILT-ROTOR

The Bell XV-3 and Transcendental's "convertiplanes" employ the tilt-rotor principle. They use twin three-bladed rotor-propellers near the wing tips which act as conventional lifting rotors while taking off, hovering, and landing. The rotor mast axis is vertical for helicopter operation. After basic forward speed is reached, the masts are rotated forward approximately 90° until they are horizontal. The rotors then act as propellers.

On the Bell XV-3, the conversion process requires 10 to 15 seconds for the lift load to be transferred from rotors to wing. After conversion, a transmission gear shift similar to an automobile overdrive reduces the rotor speed for greater efficiency of operation.

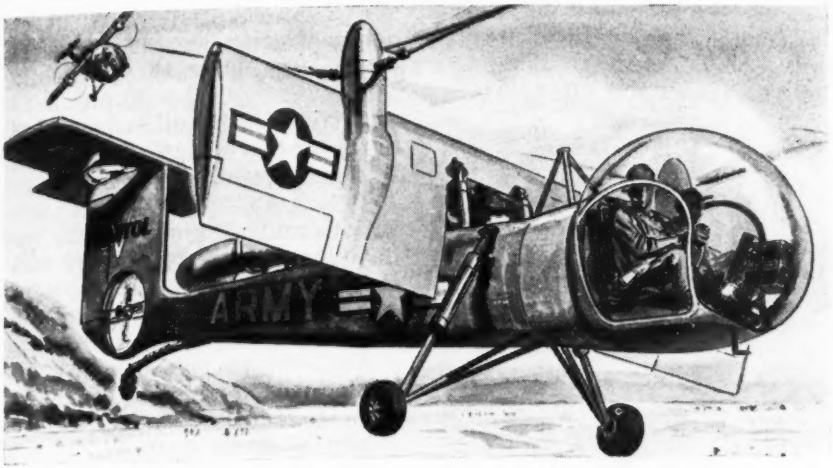
The "Shrouded Fan" is another design employing the tilt-rotor principle. The only difference between this and the Bell XV-3 is that the propellers are enclosed in a shroud which increases lift during the periods of transition and forward flight. Doak Aircraft Company has contracted to develop this experimental aircraft.

TILT-WING

Vertol and Hiller Aircraft Corporations have also contracted to study and develop a tilt-wing type aircraft. In their design, the entire wing including engines and propellers are tilted on the spanwise axis in such a way that the wing is in a vertical position for takeoff and landing. As speed in forward flight increases, the wing is slowly rotated into the conventional fixed-wing position, the fuselage remaining in normal flight attitude.

Vertol has developed a flying "testbed" for the Army in which a single T53 gas turbine engine is mounted within the fuselage to drive twin rotor-props mounted on the wing. Two duct fans are mounted in the empennage for directional control and stability.

For the Air Force, Hiller is developing the X-18, a twin-engine tilt-wing design with a gross weight of 22,000 pounds. This model will use two T40 gas turbine engines (originally used in the Lockheed "pogo" project



Vertol concept of a tilt-wing aircraft suitable for U. S. Army use.

for the Navy) and a Chase C-122 fuselage.

One of the more favorable features of the tilt-wing concept is that STOL (short take off and landing) capabilities are inherent in the design. This allows the gross weight to be increased above the maximum allowable for vertical takeoff.

DEFLECTED SLIPSTREAM

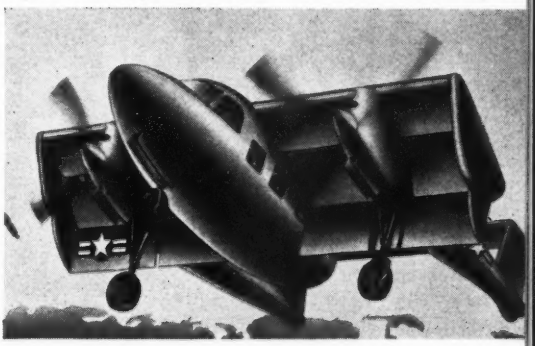
The deflected slipstream aircraft, under development by the Ryan Aeronautical Company, will embody a conventional configuration, with the exception of large flaps incorporated in the wing to permit propeller slipstream to be deflected 90° downward during takeoff, hovering, and landing. For transition into horizontal flight, these flaps will retract as the "Vertiplane" picks up forward speed, at which time the slip stream will flow horizontally.

In landing, the pilot will make an approach under power with slight flap deflection. He will then extend the flaps and add power until touchdown at zero forward speed. Drag, resulting from the use of partial flaps, helps to accomplish a smooth landing transition at almost a constant level attitude for the aircraft.

The Ryan "Vertiplane" is scheduled to be powered by a single gas turbine engine which will drive two propellers. This design also is expected to have favorable STOL characteristics with overloads.

Fairchild Aircraft and Engine

Ryan Vertiplane utilizes extensive flaps.



Corporation is evaluating a similar model employing four reciprocating engines and large flaps to deflect the slipstream.

TAIL-SITTER

The tail-sitter design places the longitudinal aircraft axis in a vertical position for landing and hovering. A typical example of this is the Lockheed "pogo" project, which received much publicity about two years ago. Only two principles are necessarily inherent in this design. The first is that thrust developed by the propeller must be greater than the weight of the aircraft. The second is a control system by which the pilot may maneuver the airplane while in hovering flight.

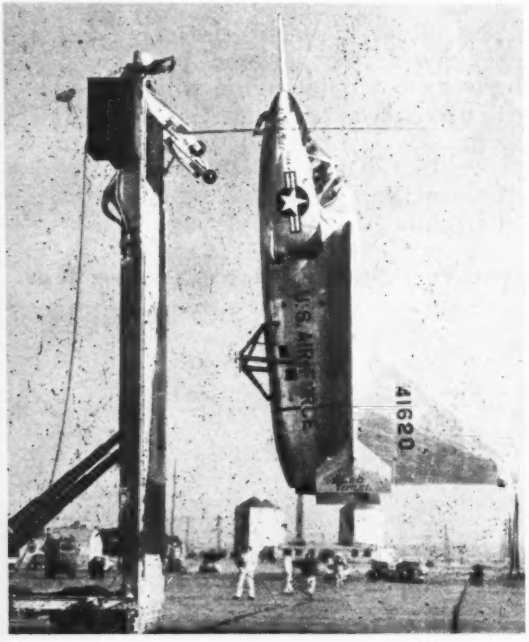
The latest aircraft to be developed under this principle is the Ryan "Vertijet." A flight demonstration, conducted on 11 April 1957, gave the public its first view of the Ryan X-13 "Vertijet." The full sequence of flight from takeoff to landing was successfully completed.

The X-13 employs a jet reaction control system. The exhaust is deflected from the surface of the landing area upward into the intricate control system and, in combination with the throttle which provides the vertical thrust necessary, gives the aircraft excellent hovering capabilities.

The plane does not have a conventional landing gear. Instead, it has a single hook mounted beneath the forward fuselage which engages a cable extended from a specially designed ground service trailer. Like the familiar dump truck, the bed of the trailer is hydraulically lifted into vertical position to receive the aircraft, then lowered to transport it horizontally.

Disadvantages of the tail sitter are that it cannot be overloaded and flown off a conventional runway, and it imposes special pilot training and passenger seating problems inherent in the vertical fuselage attitude.

Landing "field" for Ryan Vertijet.



STOL

Kaman Aircraft, under a Navy contract, is developing a new STOL concept. The system would utilize two propulsive rotors driven by gas turbine engines. The rotors will have small controllable flaps buried in their trailing edges to provide cyclic and collective control by changing the lift characteristics of the blades. (This flap control system

is also incorporated in the HOK helicopter, a product of Kaman.) This cyclic and collective system will give the pilot full control of the airplane at airspeeds under 50 mph. Above 50 mph, the flap system in the rotors automatically phases out and conventional airplane controls are used. Fowler flaps on the wing provide additional lift during takeoffs, landings, and slow flight. Kaman engineers anticipate the aircraft's speed will range from 0 to over 300 mph. (See title page.)

FLYING CRANE

Last year the Army let contracts to several aircraft corporations for the study and development of flying cranes. The object of these studies is the visualization of a large helicopter with heavy lifting capabilities for distances up to 100 miles. This new helicopter "breed" will be functionally designed for transport of as much as 16 tons of materials. All types of power plants and airframe designs are to be investigated. The overall goal is a reliable and transportable rotorcraft capable of economic operation in the field with minimum maintenance attention and spare parts.

Artist's concept of flying crane.

VTOL SPELLS MOBILITY

The Army would like all its organic aircraft to have VTOL capabilities since the modern Army depends upon quick and efficient movement into areas inaccessible to normal ground transportation. The Army, it seems, needs tomorrow's aircraft today!

Interested? See page 35 for details.

WITH ARMY AVIATION tending more and more toward all-weather capabilities, IFR flight plans in the future may become standard procedure, as opposed to the present day exception. Instrument qualification is becoming today's necessity rather than yesterday's luxury. One of the most talked about and least understood hazards of "flying the goop" is *icing*.

In spite of the progress that has been made toward overcoming the formation of ice on aircraft, the presence of precipitation in 0° to -10°C. temperatures still remains one of the greatest hazards to flight. Prior to the development of instrument flight techniques and radio navigational methods, very little difficulty with icing was experienced, because pilots attempted to avoid flight through areas in which icing was present or likely to occur.

Views expressed in this article are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor

TYPES OF ICING

There are two types of icing that may be encountered in flight. *Rime* ice, which consists of a white, rough, opaque structure that builds up and out to the windward, is comparable to ice seen on refrigerator coils. *Clear* or *glaze* ice is hard and glassy and is the type formed in ice trays. There may be several grades of the two main types or the ice deposit may consist of various combinations of the two.

Of the two main types, glaze ice offers the greater hazard to flying, because it is harder to crack off. Rime ice forms unevenly and jaggedly and will sometimes crack off because of the velocity of airflow over the airfoil.

Before ice can form, two conditions must exist: (1) moisture must be present, and (2) the temperature must be at or below

freezing. The kind of ice which will form depends upon the size of the water droplets present and the temperature. When the droplets are small and the temperature low, rime ice forms; when the droplets are large and the temperature is at or just below freezing, clear ice forms.

Water droplets cooled below 0°C. are called "supercooled." If the droplets impinging on an aircraft are small and the temperature low, the final freezing occurs quickly, forming rime ice; but if the droplets are large and the temperature is just below freezing, they may spread out into a thin sheet and form clear ice.

During contact flight, the most serious icing is caused by *freezing rain,* which is encountered when flying through below freezing temperatures where rain is falling. This would usually be a glaze or clear ice formation, but it may also be mixed with snow or soft hail, producing a rough and jagged appearance.

During instrument flight all types of ice may occur when the free air temperature is freezing or lower and the airplane is flying through clouds or rain. Cumuliform clouds are normally composed of large droplets, while stable air clouds such as stratus or fog are composed of small droplets.

AREAS ASSOCIATED WITH ICING

About 85 percent of aircraft icing occurs in frontal zones. Typical *warm front* clouds are stratiform in character and may contain only a small vertical component of circulation, but the upward displacement of a great mass of warm air may produce thick cloud systems and heavy precipitation with large droplets. The rising warm mass possesses the potential to form cumuliform clouds. Clear ice or a combination of clear and rime ice may result. Warm front cloud systems are often extensive, causing flights in them to be of long duration with increased danger of severe icing.

Typical *cold front* clouds are cumuliform and may cause the formation of clear ice. The cold front cloud system is relatively narrow compared to the warm front system, so that the period during which icing may occur on a flight across the frontal zone is shorter. However, the combination of clear ice and a higher rate of accumulation makes cold front icing zones extremely hazardous.

Icing is more probable and severe in mountainous areas. Mountain ranges cause upward circulation on their windward side. Vertical circulation over the ridges will support large droplets. The most severe icing will take place on the windward side of the ridges.

EFFECTS ON AIRCRAFT

An aviator should be thoroughly familiar with the weather and temperature conditions which may cause ice to form on his aircraft. Equally important is an understanding of what happens to the airplane when unexpected icing conditions are encountered. A knowledge of the effect of ice formation on the flying characteristics of the airplane will in most instances enable the pilot to quickly readjust his flight procedure to meet the increased demands placed upon

the aircraft. Ice forming on the aircraft will cause a loss of lift and an increase in weight (sometimes critical at the time of takeoff). The change in configuration will add to the drag; the stalling speed will become dangerously high; and the glide angle will be surprisingly steep.

The Army Aviator should not forget that his propeller is also an airfoil and will tend to accumulate ice just as his wings do, resulting in a condition similar to a loss of power from carburetor ice. The efficiency of the propeller is lost, and thrust is greatly reduced. A series of changes in rpm will normally dislodge the ice.

Icing on the propeller may also be detected by closely checking for engine vibration. This vibration occurs when ice forms unevenly on the blades or when one blade throws off ice, producing an unbalanced condition.

Any part of the aircraft can be affected by an icing condition. Freezing of the controls may result when flying from rain into freezing rain, or when flying into subfreezing temperatures immediately after the ship has been washed.

Pitot tubes may ice up, affecting the airspeed indicator or other instruments. Windshield icing restricts forward vision from the cockpit. A severe accretion on antenna masts and wires may cause radio failure. Finally, a partial vacuum may result from frozen fuel tank air vents which could cause fuel starvation.

Icing on a helicopter is similar to that on fixed-wing aircraft, but it is harder to detect. The airfoil of a helicopter is in constant motion, and the rotor blades may accumulate ice before the pilot realizes it. The physical dimensions of the airfoil of a helicopter are much smaller than those of a fixed-wing aircraft and the helicopter's airfoil is more readily affected by deposits of ice.

Icing may be detected on small helicopters by accumulations on the bubble, the swash-plate, or the skids. On larger helicopters, where the visibility of the rotor head is more restricted, the first indication may be a light icing of the windshield or landing gear.

Icing on the rotor blades is indicated by a loss of efficiency which necessitates an increase in power. As the ice continues to form, power must be continually added, and vibrations may occur and increase in intensity.

PROCEDURES TO FOLLOW

Generally, the best procedure for a helicopter pilot to follow after confirming the presence of ice is to select a suitable landing site and land as soon as possible, taking into consideration the loss of efficiency of the rotor blades. In some situations, such as above water, in mountainous terrain, or past the "point of no return," a suitable landing site may not be available and a "one eighty turn" offers no solution.

Experience has taught some helicopter pilots that, as an emergency measure, ice deposits may be removed from main rotor blades by a decisive application of collective pitch in the upper control range, throwing the ice up and away from the helicopter. This procedure must be accomplished prior to excessive ice

accumulation and, depending upon the severity of icing and distance to a landing site, may require repeated application.

The above procedure should be used cautiously, for an abrupt, rapid movement of collective pitch to the minimum setting, together with the added weight of ice deposits, may cause the blades to flex excessively and strike the tail boom; or ice deposits may dislodge and be thrown into the tail rotor when blades flex excessively low. In any event, removing ice through collective pitch application should be used *only* as an emergency procedure until a suitable landing site is reached.

An Army Aviator who encounters icing conditions in a fixed-wing aircraft on VFR flight must take decisive action immediately. The safest procedure is to turn back, making the turn slowly to keep the airplane from stalling under extra load. A landing becomes imperative if the ice continues to build, and should be made before the stalling speed becomes dangerously high.

On the final approach, normal glide speed is not sufficient to prevent stalling, and engine rpm should be kept above normal to help offset the unfamiliar increased glide angle and the tendency to stall suddenly. Engine power also helps to keep better control and opposes the tendency to nose-over if the ground is soft or the brakes are frozen. If a landing is not effected on the first approach, the aviator should take care not to climb or bank too steeply in subsequent turns.

Under IFR conditions where the pilot is flying on airways, if icing conditions are encountered, he should make a turn (preferably to the right), *clearing the airway*, and climb immediately until a warmer air mass is contacted or an altitude is reached where the temperature is well below freezing.

In any situation where the aviator may deviate from his IFR flight plan, he must notify the nearest CAA or ATC facility, and he must stay out of controlled airspace once he has cleared it. However, if he elects to remain in controlled area, he must maintain his prescribed altitude and direction until cleared by ATC to make a change.

In an emergency situation, after clearing the airway and commencing to climb, a check should be made to see if ice is still accumulating. If so, an aviator has two alternatives. The first, and by far the most advisable, is to make a 180° turn, staying clear of the airway, and hope that he is out of the icing condition before the accumulation on his aircraft becomes too great. On the other hand, he may elect to continue climbing to even greater altitudes, hoping to reach a point where the icing will cease. This procedure is not advisable because the ice may accumulate so rapidly that all lift will be lost before reaching a "safe" altitude.

In an emergency, an aviator may elect to descend, remain at the same altitude, or climb to eliminate the dangerous condition. Any deviation from his IFR flight plan without the consent of ATC should be reported as soon as possible and an amended clearance obtained (CAR 60.21). Report of this should be sub-

mitted to the aviator's commanding officer within 24 hours and to Military Flight Service within 48 hours after a landing has been effected.

The most logical flight plan is one in which icing conditions do not prevail along the route. Flights usually may be routed through a safe area. If this is impossible, the flight should be CANCELLED. The safest place for an aircraft when icing conditions prevail is in the hangar.

GENERAL RULES

Specific rules can not be applied when icing conditions exist, for the action taken by the aviator will depend upon many factors — the terrain, the aircraft, visibility, etc. The following is a list of cautions that may help when icing conditions are imminent.

1. Since heavy cloud turbulence normally means heavy icing conditions, skirt the obvious danger areas if practicable.

2. Don't fly through rain or wet snow when the temperature at flight level is freezing or slightly below.

3. Don't fly parallel to a front under icing conditions.

4. Don't make steep turns with ice on the airplane.

5. Don't land with power off when ice has formed on the wings and on exposed surfaces of the aircraft.

6. Since stalling speed is higher than normal with the aircraft iced, maintain adequate airspeed in climbs and glides.

7. Don't attempt a steep approach or quick stop in a helicopter when ice has accumulated. Make all control movements smooth and timely.

8. Don't fly into any form of moisture with the temperatures between 0° and -10° C.

Most Army aircraft are not equipped to be flown in icing conditions. An Army Aviator must know what to do when icing is encountered and be familiar with the aircraft he is flying. Flying into known icing regions shows a lack of planning by the aviator and a need for more stringent supervision.

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Static Fatigue

Colonel William H. Byrne, MC

THE PILOT OF AN L-20 snapped suddenly erect in his seat. Another aircraft was approaching directly ahead, where, a moment before, nothing more menacing than terrain, blue sky, and white cumulus was visible. Quick evasive action averted a head-on collision.

Chances are that his trouble was static fatigue, which frequently affects aviators. This is true fatigue resulting from sluggish body function and associated changes in body chemistry. It is tiredness caused by doing almost nothing.

Static fatigue occurs during periods of relative inactivity which results in lowered body requirements, slower circulation, slow shallow breathing, decreased metabolic activity, and a relative stagnation of body fluids. A vicious cycle is created by decreasing the physiological demands and in turn the body's response. Sleep will result unless the cycle is broken. This type of fatigue, which occurs during flight, can be aggravated by other factors, including lack of preflight rest, prolonged exposure to noise and vibrations, varying degrees of illness, lowered oxygen content inducing mild hypoxia, loss of salt, exposure to a very dry atmosphere, or poor motivation.

Army Aviators are familiar with effects such as drowsiness of which they are often unaware until suddenly jolted back into reality like the L-20 pilot, who was surprised to find himself facing an emergency. The condition also leads to lethargy, boredom, and loss of attention to surroundings. A particularly ominous and sometimes fatal complication is decreased reaction time.

Some of the things that can be done to make the time fly by

Colonel William H. Byrne is the Flight Surgeon, the U. S. Army Aviation School. *Views expressed in this article are the author's and are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor*

Don't overeat.

and keep an aviator constantly alert during flight are startlingly simple. Primarily, the pilot must enjoy what he is doing. He must know at all times where he is and what routine flying is being conducted in that vicinity. If an area or route briefing is not available, he must devote some preflight time to the geography and activity along the route and study NOTAMS. He should keep busy, feeling that everything possible is being done to make the flight profitable, and one from which a deep satisfaction of accomplishment can be derived.

Many pilots simulate emergency procedures at frequent intervals. This not only fights boredom but in that flashing moment *when one must act* they accomplish necessary procedures automatically.

By all means, keep aware of everything—live in the present, this moment. Awareness will keep you in the land of the living.

Adequate rest is a primary necessity. Sleep at least eight hours before a long flight since inflight rest creates another difficult problem. Breathe deeply at intervals for several separate one-minute periods, and at least one-half hour before critical phases of flight, such as landing. This speeds up circulation and improves various body functions essential to the completion of the immediate mission.

Do not overeat before a long flight. Small amounts of food taken frequently prove more satisfactory in avoiding sluggishness than large amounts at one time. Cabin atmosphere is apt to be dry, so drink plenty of water, milk, and canned vegetable or fruit juices. (Tea and coffee are less desirable because they promote elimination of water.)

Exercise is a very important method of combating static fa-

Cockpit calisthenics.

tigue. Space does not permit cockpit calisthenics, but surprising results can be achieved by toe wiggling, flexing and extending the limbs, changing position and stretching. Another method is antagonistic muscle exercises which pit one muscle group against another, such as tensing the muscles of the upper and lower extremities. All of this helps to relieve tense muscles and stimulate circulation.

On long flights, the pilot should wear comfortable clothing to maintain adequate ventilation and body heat. He should protect his eyes from sun glare. In rough air, the seat belt should be tight enough to hold him firmly in his seat. All this contributes to combating undue tension and fatigue.

Thus, we can see that emphasis should be placed on the paramount requirement for successful flying, namely, unequivocal alertness. This must be an inherent trait fortified by a high level of endurance and tolerance in each qualified pilot. Add experience to these and the individual will be able to make the most of each flight, steadily increasing his proficiency and confidence. In short, he remains a student who works and learns throughout the flight instead of sleeping, daydreaming, and thus contributing to the circumstances which could easily lead to a mid-air collision.

Accident Prevention Survey Available

How do you know if you have a safe operation? The absence of accidents does not assure safe practices or accomplishment of your mission. The U. S. ARMY AVIATION SAFETY BOARD has recently prepared an Accident Prevention Survey. When properly used, this survey will bring to light conditions that might endanger your mission during ground or flight operations, pilot training, mechanical repairs, etc.

It covers everything from SOPs to obstruction lighting. It is not mandatory, however, and does not call for official action. The survey will enable you to see your own big picture and to determine where the elimination of hazards is both necessary and easily accomplished.

The survey is adaptable to either large or small airfields and your unit operations officer can obtain a copy by writing to the U. S. ARMY AVIATION SAFETY BOARD, Fort Rucker, Alabama. The survey with instructions enclosed will be forwarded to you immediately.

The only book of its kind in the world, monographs of Army Aviators' experiences in Korea, is shown being taken out of the stack by an assistant librarian. This document was specifically written to provide original historical material for library users.

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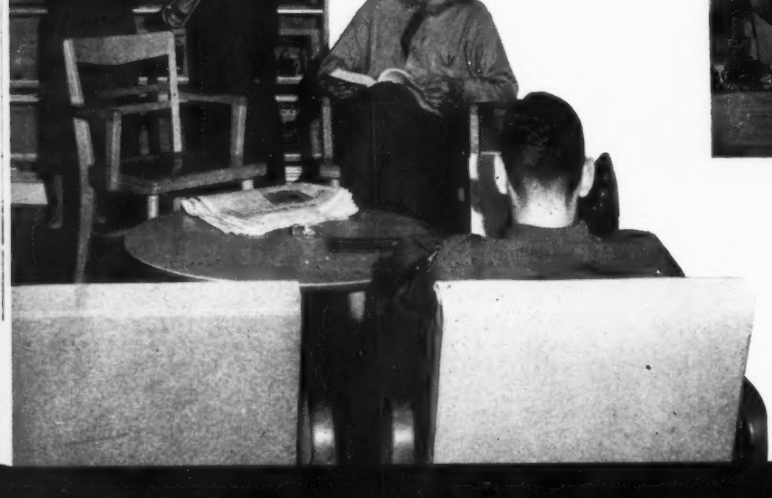

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MY AVIATION LIBRARY

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An assistant librarian aids an Army Aviator in preparing material for a lesson plan. The library also furnishes reference and bibliographic material by correspondence, thus assisting in the preparation of lectures, speeches, and briefings for aviators everywhere.

k E. Ingle, the Aviation School processes the requests for use of students of the nd General Staff ort Leavenworth, Army officers in ado, Arma, and to assist research ies in Washing- and Northern ifornia.

More than a million flight hours are represented by these flight records being referred to by a civilian flight instructor. These are student flight records filed for future reference in the library. Currently material is being added at the rate of 1,000 items monthly. A comparable increase in quality is possible if Army Aviators will make known their requirements and make full use of the library.

THE BIG SCARE

Calhoun Norton

I WAS fifteen feet off the ground.

I was in a right turn. Yet I was holding full left rudder and full left aileron. My right prop was feathered. The stall warning horn was blowing like mad. Straight ahead the top of a palm tree stuck up above the horizon. Beyond it lay the Florida swamps. The roof of my mouth was dry. Beads of sweat became rivulets. I was scared. In fact I had never been so scared in the nineteen years I had been flying.

Later I realized that I had witnessed, indeed participated indirectly in, a similar harrowing experience nearly ten years before without being aware of it at the time. On that occasion my Howard had been parked just off the taxi strip in the southwest corner of the field at Lantana, Florida. I looked up momentarily and notice a Grumman *Mallard* taxiing northwest on runway 15 for a southeast takeoff. Having heard remarkable things about the performance of this ship, which I had not seen before, I decided to watch it take off. I started the Wasp in my own ship and again looked up just as the *Mallard* pilot poured on the coal. Its two engines roaring, it charged down the runway and broke ground at about midpoint. Shortly after this the noise diminished perceptibly, the right prop began windmilling and then was feathered.

I thought to myself, "Oh, oh! Here's trouble!" But the big ship seemed to continue its normal climbout. I marvelled at this but put it down to a demonstration of single-engine performance and returned my attention to my own ship. I applied a little throttle and pulled out on the taxi strip heading for the gas pits. At this point I observed that the *Mallard* had described a wide arc to the right and was now headed straight at me in a shallow dive, its right prop still feathered.

Again I thought that he might be in trouble and was attempting to land on the taxi strip so

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Calhoun Norton is president of Arens Controls, Inc. Holder of a private license since 1927, he has logged more than 2,200 hours and is instrument rated. *This article first appeared in the March, 1957, issue of AIR FACTS.* *Views expressed in this article are the author's and are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor*

Sirs:

I'm glad you were able to use my article, "The Big Scare." I thought perhaps you would be interested in hearing that since writing it I have experienced an actual engine failure on takeoff.

On our way to Lantana, Florida, from Chicago, my wife, my daughter and I put into Vero Beach for fuel. With full tanks and enough baggage to bring us very close to maximum gross weight we lined up at the end of runway 29, - 7160 feet long. At about mid-runway we had the gear up and about 100 mph indicated when I noticed the props were out of sync. RPM was dropping off on #2 and I followed it with #1 pitch control for a moment. The drop-off rate increased on #2 so I looked at the oil pressure. It was zero.

I pushed #1 to the stops and feathered #2, securing it. By this time we had gone too far to land straight ahead. We climbed out at 110 to 120 mph with no trouble. Service facilities being better at Lantana than Vero we climbed to 2000' and continued to our destination, landing with no further incident. By using very little power and staying on the pavement we were able to taxi back to the line on #1 only.

A plug which worked loose and allowed air to enter the system turned out to be the trouble and feathering was accomplished before any damage occurred to the engine. I firmly believe my research paid off.

CALHOUN NORTON

I headed off to my left to give him room. I had just gotten off onto the sandy grass when, with its one operating engine roaring, the *Mallard* sailed over my head very low.

Fuming with anger I resumed my journey to the gas pits, muttering something about pilots who include single-engine buzz jobs on unsuspecting pilots on taxi strips as part of their demonstrations. At the same time I could not help admiring the superb performance of the ship and the consummate skill of its pilot.

You see, at that time, as a strictly single-engine pilot, I had never even heard of MINIMUM SINGLE - ENGINE CONTROL SPEED! Pardon the capitals. I have since seen this written as V1, Vse, Vmc, etc., but it is my

firm conviction that this all-important speed cannot be spelled out too plainly!

NEW OWNER

In April of 1955 I acquired my own twin-engine ship, a Cessna 310, N2657C. My transition training to a multiengine rating consisted of 8½ hours of which 6½ was a pair of trips to Detroit from Chicago involving a total of four landings and takeoffs. In addition to this I was given an Owner's Manual on the 310 to study and a simple examination to show that I had studied it.

In this Owner's Manual a total of 162 words involving five separate references, much of it repetitious, was devoted to minimum single-engine control speed. In a single paragraph in the same manual 288 words were devoted to the care and cleaning of the upholstery.

A subsequent revision of this manual increased the number of words on minimum single-engine control speed to 200. It also increased the minimum single-engine control speed from 90 to 93 and the recommended single-engine approach speed from 90-100 to 105.

The sum and substance of this manual (revised) on minimum single-engine control speed is as follows:

Under Emergency Procedures:
ENGINE FAILURE DURING TAKEOFF BELOW 93 MPH

(1) Cut power and decelerate to a stop.

Note

The airplane can be accelerated to 93 mph and be decelerated to a stop with heavy braking within 3,200 feet of the starting point of the takeoff run. (Zero wind, dry hard-surfaced runway at sea level, with maximum gross weight).

SINGLE-ENGINE LANDING

(1) Approach at 105 with excess altitude.
(2) Delay the extension of landing gear until within gliding distance of the field.
(3) Avoid use of flaps until landing is assured.
(4) Decrease speed below 93 mph only if landing is a certainty.

Note

When speed drops below 93 mph the airplane is committed to land because a climb out at full throttle is impossible at any speed lower than minimum single-engine control speed.

The directions were explicit enough, but I like to know why. So I asked my check pilot why the airplane was committed to land as long as it had flying speed and one good engine. Power off stalling speed with gear down and 15 degrees of flap was shown in the manual as 77 mph.

"Why 93 mph?" I asked.

"Oh that's your single-engine control speed," I was told. When I asked what this meant my check pilot vaguely replied, "Oh, I dunno, I guess you just can't control it if it goes any slower on one."

In the air I was shown the procedure for feathering and securing a dead engine from cruising speed. I was impressed with the fact that one could chop an engine from cruising speed without any compensating trimming and with one's feet on the floor,

control the ship easily, making turns in either direction with the wheel only. By properly trimming the ship it could be flown hands off with either engine feathered. The check pilot also assured me that a close simulation of single-engine flight could be set up by using 12 inches manifold pressure and 2000 rpm on the simulated dead engine, thus avoiding the necessity of actually cutting an engine for maneuvers close to the ground.

We set up this condition and he showed me the procedure for single-engine landings. "Trim it for hands-off flying," he said, "and you can handle it just like a single-engine airplane, except don't put your gear and flaps down until you are on final."

We made an approach and just after we turned final I let down the gear and put on about 15 degrees of flap. Our airspeed quickly dropped from 100 mph to about 90 and the approach looked a little short to me.

In a single-engine ship I would have added a little power, so I opened the throttle on my simulated good engine, the left one. The right wing dropped and a steep turn to the right was started. In this situation you obviously could not "handle it just like a single-engine airplane." I reduced power, realigned the ship on the runway and we made it all right. If we had really been short, though, and an engine had really been out the results of this approach would have doubtless been quite different.

To my check pilot I said, "I guess we must have got a little below minimum single-engine control speed." The reply was, "Yeah, I guess we did." To myself I said, "This I must find out more about."

YOU LIKE TO KNOW

I took delivery of my 310 in April and in June I went to Ft. Lauderdale for the installation of an HF radio for my impending trip to Europe. I had been getting as much experience on the ship as possible and as I flew over an abandoned Navy field near Melbourne it occurred to me that this would be a good place to try out a couple of things I had been curious about.

A friend of mine had once said to me, "Sometime you should try a full-power takeoff but cut everything about five feet in the air and try to land again. It may surprise you how much room it takes." I don't like surprises in airplanes so I thought I'd try it.

This field had three black top runways 4,000 feet long which I thought should be enough. I made a landing as short as possible and observed that full stop took about 1,000 feet. Then I made a takeoff as short as possible with about 15 degrees of flap. I was five feet in the air in about the same distance or less. Next I combined the two. The takeoff and landing were accomplished in about the same distance as when practiced separately and the additional space consumed in setting up a landing condition left me with about 800 feet of unused runway which pretty well confirmed the figures in the Owner's Manual.

I have said I do not like to be surprised in airplanes. Often I have deliberately set up conditions which are extremely dis-

concerting in order to be prepared for them in case I should inadvertently stumble into one. I felt that I was now ready to set up such a condition—loss of an engine on takeoff. I had simulated this many times at a respectable altitude and now I wanted to do it on an actual takeoff.

I felt that prudence demanded that the first attempt be made with a windmilling engine at reduced power to keep from burning my bridges. If things did not go as advertised I could always pour the coal to the "dead" engine.

With some trepidation I started down the runway with about 15 degrees of flap and on breaking ground accelerated to 93 mph, picked up the gear and throttled the right engine to simulated dead engine conditions —12 inches and 2,000 rpm. No sweat. With my feet on the floor I could hold her on course and maintaining about 95 climbed right out.

I now had enough confidence to give myself the worst scare I have ever had in an airplane. As I came around for the landing I thought to myself, "Now, how about actually cutting one on takeoff?"

I had tried this at altitude and had just simulated it on an actual takeoff. So far so good. I had cut both engines on takeoff and landed straight ahead with room to spare. If worst came to worst I thought I could do this again. I decided to give it a whirl.

THE REAL THING

Landing short I taxied back to the very edge of the runway, checked everything, set up about 15 degrees of flap, lined up and opened the throttles wide. I picked up the nose wheel as soon as it would come and flew off somewhat tail low. As soon as I broke ground I picked up the gear and glanced at the airspeed. At 93 mph I pulled the idle cutoff on number two and then feathered it!

Before I had time to think I knew I had a fight on my hands. I could not possibly have cut the other engine and landed straight ahead because by the time number two had feathered I had entered a turn and was off the runway! Full left rudder and aileron only flattened the turn and I skidded over the ground noticeably. I had no time to even look at the airspeed because a palm tree loomed up ahead and the stall warning horn started to blow at the same time!

I eased off a little on all controls to pass the tree to the right and to stop the horn from blowing. As speed picked up a little the hornblowing became intermittent but I still could not get any altitude and I could not steer a straight course. By this time I was at about 120 degrees to the course I had taken off on and was over the swamps surrounding the airport.

While sweating out the delicate balance between losing directional control and just plain settling into the ground I thought of the flaps. Cautiously I reached for the switch and eased off the flaps a little at a time. Speed picked up and the horn quit blowing. My course straightened out and I was able to ease off a little rudder and aileron.

"Now," I thought, "can I start that right engine or will it put me right back behind the eight ball if I get it windmilling and it won't go!"

I decided to try it.

I pushed the prop and mixture control forward, turned on the switches and hit the starter. The engine caught and as suddenly as they had overwhelmed me, my troubles left me. I eased on the throttle gradually, allowing a little time for warmup, and as flight became normal I looked back from disaster to the Florida landscape and uttered a tremendous sigh of relief. The roof of my mouth was dry and the sweat stood out on my forehead and ran down my chest and back as I sat there and slowly recovered my composure.

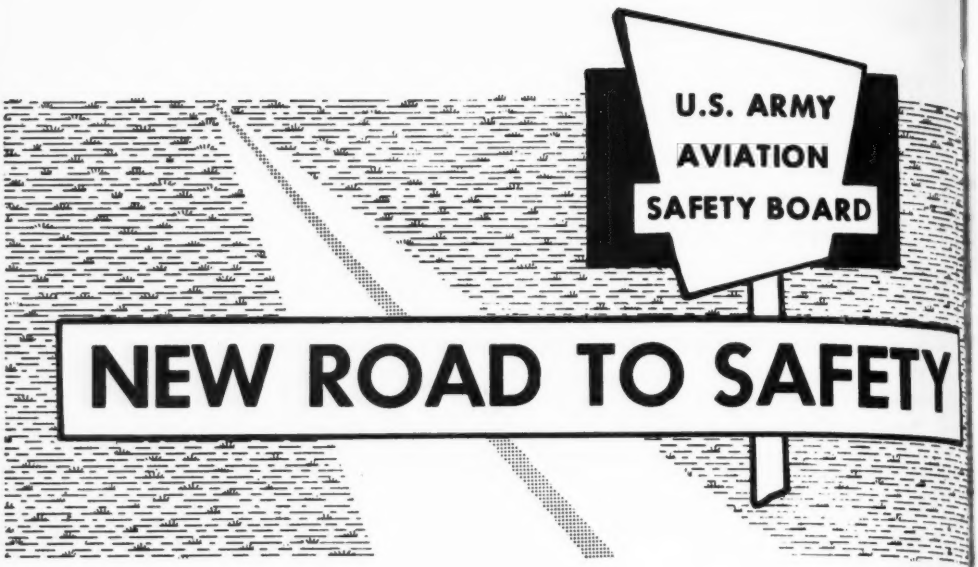
THE KEY POINT

It has been said that the cheapest commodity you can buy is experience if you can get it secondhand. It was with this thought in mind that this article was written. I am concerned with the vast number of pilots who, like myself, have recently or are about to undergo the transition from single-engine to light twin aircraft. I offer you my experience secondhand for the price of reading about it. I sincerely hope that your check pilot can use this article as a means of satisfying your natural curiosity in the matter of minimum single-engine control speed. I strongly urge you not to try it firsthand as this could prove to be very expensive to life, limb and property.

Since initial cost, maintenance and operating expenses are much higher, the primary reason most of us buy twins is safety. With an engine failure at altitude even a single-engine pilot has a little time to look for a place to put it. The most hazardous spots for an engine failure are on takeoffs and landings, and remember, with a twin you have twice as much chance of losing one. A single-engine pilot who loses his power on takeoff or landing still has control as long as he maintains flying speed, but the pilot of a twin who does not understand minimum single-engine control speed may be riding a completely unmanageable monster. Knowledge of this speed and strict observance of it can provide the safety you thought you bought with your twin, but this knowledge must be built into the pilot since it is not built into the airplane.

Since learning the hard way, the first thing I do after any takeoff is to accelerate to at least five knots above minimum single-engine control speed. On all approaches I maintain at least five knots above minimum single-engine speed until a landing is assured.

I have made two forced single-engine landings. One at Greenland, due to inadvertently shutting off my special auxiliary tank, as described in AIR FACTS ("Heart's Desire" April, 1956), and one at my home port when an oil pump gear broke in half on the left engine. On both, my speed over the boundary of the field was 100 mph, and there was no sweat. As yet I have not lost an engine on a takeoff and I hope I never do, but if I do it will not surprise me, nor will it catch me napping. How about you!



LIAISON PILOT — a rare breed of aviator, characterized by boldness, three-button watches, dark glasses, and extreme independence. Flies light unarmored aircraft, low and slow. Best known for taking chances when unnecessary. Involved in many accidents. Now extinct, replaced by Army Aviators.

So we have replaced liaison pilots with Army Aviators. The accidents and the chance-taking, however, are still in effect. As Army Aviators flew low and slow, the accident rate went up and up. Around 1950, aviation safety began to get organized. Rex Riley posters began to appear on bulletin boards along with the girlie pictures from the Flying Safety magazines. All of this does not mean that some conscientious Air Officers had not been trying. All along they had known that good training, safe flying, and sound mechanical practices would save lives and aircraft—maybe their own.

By the early 50s, the Army aircraft accident rate had reached such a high that immediate action was needed. The Aircraft Accident Review Board was established at Fort Sill and accident reports were sent there for review. The reviews brought many things to light, among them, a need for an organized safety program.

Many conferences later, an organization to initiate and carry out an Army aviation safety program was decided upon. It would be called the Army Aviation Safety Board. Its activities were to cover Army aviation throughout the world. Some nicknamed it the "World-Wide Safety Board."

In January of this year the United States Army Aviation Safety Board became a reality. AR 15-76 established the Board as a class II activity at Fort Rucker, Alabama. In comparison

Views expressed in this department are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor

with the Air Force and Navy Flying Safety organizations, the Army board is small. The scope of activity, however, will cover nearly every phase of aviation. The Army Aviator, his aircraft, and his flying will experience changes as a result of Board action.

In one recent year, aircraft accidents cost the Army an average of $25,000 a day. The same accidents took the life of one Army comrade approximately every 7½ days. Fortunately, these figures have dropped some lately. In an effort to keep the rates down, the Safety Board will engage in several activities:

1. Army aircraft accident reports are kept on permanent file at the Army Aviation Safety Board. These reports are always being studied and evaluated for statistical information, worldwide trends, and dangerous conditions. The new deal here is to send the results of your reports and our analysis to the field for the purpose of preventing future accidents.

2. Investigate accidents of an unusual or unknown nature.

3. Aviation safety literature will be prepared and disseminated.

4. Liaison will be maintained with other agencies engaged in aviation safety work, so that the Army might profit from their activities.

5. The Board will recommend to and advise the Department of the Army on any action that will make flying safer.

The flow of information on flying safety will go from the Board to the field in several ways. For best results, the Board must be kept well informed by units in the field. This is where you get into the act. Let the Board know about your problems that could affect flying safety. Tell them about your solutions to unsafe situations. Inform the Board when you *almost* have an accident. Perhaps that will keep someone else from having the real thing.

Getting in touch with the Board is painless. Direct communication on safety matters is authorized. Your m e s s a g e, whether written in military form, using the best King's English, or penned on a postcard will receive the same attention. If you desire an answer to your correspondence, you will receive it—direct.

The members of the Board are experienced aviators and graduates of the University of Southern California Aviation Safety Course. You will see these Board members in many places, doing many things. You may meet the liaison officers at an Air Force base, an aircraft manufacturer's facility, or in an airline office getting the latest information on safety. Perhaps you will have the not-so-pleasant experience of meeting a Board investigator at an accident scene. When you see a Board member, step up and introduce yourself. He will be glad to see you and hear your views on aviation safety. Flying safety is his business and your business, so you have a lot in common.

Direct communication with the Board may be accomplished by letter to:

Director
The United States Army
Aviation Safety Board
Fort Rucker, Alabama

Pickups and Drops

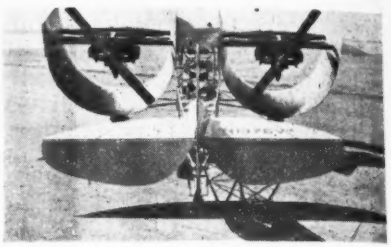
FOUR COMMERCIAL FLYING SCHOOL operators have received U. S. Army contracts to provide instrument flight training to Army Aviators.

The courses will parallel the instrument flight course at the U. S. Army Aviation School, Ft. Rucker, Ala., and will consist of 80 hours of flight and 180 hours of ground school in eight weeks.

First and Second Army Aviators will be trained by the Hinson Aviation Company of Baltimore, Md.; Third and Fifth Army Aviators will be instructed by the Central American Airways of Louisville, Ky.; Fourth Army Aviators will be trained by the Spartan School of Aeronautics, Tulsa, Okla.; while Sixth Army Aviators will receive their instruction from the Taloa Academy of Aeronautics, Oakland, Calif.

The Custer Channel Wing Corp. has announced that the CCW-2, a 2-place craft capable of in-flight speeds from 5 to 200 mph, will be ready for flight testing this summer.

Designed by Willard L. Custer, the prototype will be powered by a 240 hp engine designed to give 4,000 fpm rate of climb and enable it to clear a 50 foot obstacle in 300 feet. The most unorthodox feature of the Custer plane is the channel configuration of the wing, a half-barrel shape of approximately the same diameter as the propeller. The

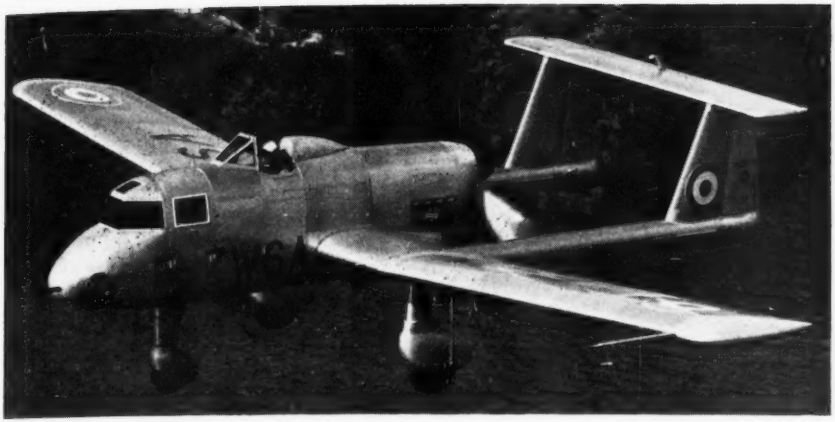


Custer Channel Wing

channels are located just forward of the pusher propellers. In operation, the propeller is said to create lift with almost no forward movement by pulling great volumes of air across this semi-circular section of airfoil.

One aircraft company insures removal of rivet bucking bars and small tools from aircraft prior to flight by imbedding a small radioactive source in each tool. It can then be located easily by a scintillation counter during the preflight inspection.

Henri Potez, French aircraft designer, has built a light airplane, known as the Potez 75.



Potez 75—a French design—features engine in rear.

It is intended for use as a low-cost aircraft suitable for operation from small airfields by club-standard pilots. The engine is in the rear to allow the best possible view for the observer seated in the front cockpit. The pilot has an open cockpit above and behind the observer. The structure is all metal and suitable for mass production.

It features a twin-boom short fuselage configuration. The underside of the fuselage has a straight line tapering to the in-line engine mounting at the back, ending in a small belly intake. Wings have a high aspect ratio, with constant chord and slightly rounded tips.

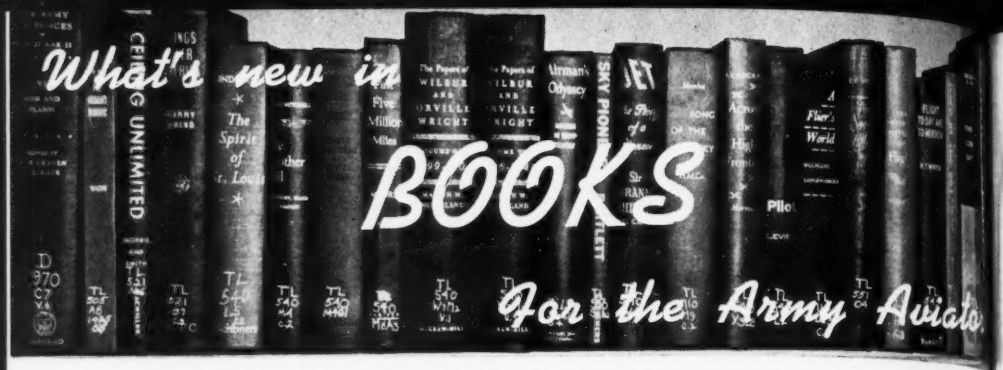
The twin booms are thin, and at the rear carry the twin tail-fins which have constant taper on leading and trailing edges. The undercarriage is fixed, with mainwheels under the booms. Empty weight is 3,693 pounds with a gross weight of 5,290 pounds. Cruising speed is 152 mph with a range of 466 miles.

Mention of any specific item in this department does not constitute indorsement or approval by the Department of the Army or the U. S. Army Aviation School.—The Editor

The single place XROE-1 collapsible rotorcycle can be put together in less than 10 minutes according to its manufacturer. It is assembled and disassembled by means of quick-release pins. The entire craft weighs less than 250 pounds, has an 18-foot main rotor and a small tail rotor located on a tubular beam.

A new, early warning, weather-avoidance radar system, which will enable pilots to "see" and avoid storms up to 50 miles ahead, has been developed by RCA.

The new radar system is reported to be the smallest and lightest of its type ever developed. It weighs only 50 pounds and is specifically designed for the "flyweight" requirements of business and private aircraft.



STORMY LIFE—Ernst Heinkel (E. P. Dutton & Co., Inc., 300 Fourth Avenue, New York 10, N. Y., 1956. $4.75)

Reviewed by
Captain Theodore Ferry
The United States Army Aviation Safety Board

It is an uncomfortable feeling, somehow, to read "Stormy Life", one of several books written recently by former enemies of America. Ernst Heinkel fooled and foiled us for over 40 years, and that is difficult to swallow with a big grin.

The book is an excellent account of the German aircraft industry from 1908 to 1950. In the early years, at the turn of the century, when America was devoted to the flimsy aircraft of Glen Curtiss and the Wright brothers, Germany was devoted to the Zepplin. At the age of 20, Heinkel watched the Zepplin LZ-4 burn to cinders and decided that the future in aviation lay with aircraft heavier-than-air. This episode launched him on an aviation career that, in less than 10 years, saw him as the designer of more than 30 types of mass-produced aircraft for the World War I German air effort. It is a great tribute to the young man Heinkel that on the day the LZ-4 crashed, he was still a student in high technical school and six years later was a key figure in the Austrian, Hungarian and German air circles. Coming from a humble home, his stubborn determination to design good aircraft gave him a lead on others in the field. Throughout his life Heinkel has been a designer at heart, and it seems almost incidental that industrial empires have risen bearing his name.

At the end of World War I, the first empire was destroyed. In a scant three years, Heinkel was again working on military aircraft, this time secretly under the very noses of the Allied Control Commission. Although several countries encouraged this activity, most business was done with the Japanese. Even America contribuated to this clandestine effort with a request for a submarine-based reconnaissance plane. The period between World War I and II is spiced by meeting with great people of the aviation and military world. Contact with Goering, Speer, Hitler, Udet, Schacht, Lindbergh, and others comes as casually as talking across the back fence with neighbors. During this period, nearly all German aviation activities were directed along military lines. His planes were good, and they broke several international records, including the world speed record.

Heinkel went through World War II with the zest and enthusiasm expected of an engineer who has almost unlimited funds and facilities at his disposal. Several of his craft were very successful and he pioneered many times in the field of rockets and jets.

Considerable space is devoted to the

Book reviews appearing in this department do not necessarily reflect the opinions of the Department of the Army or the U. S. Army Aviation School.—The Editor

reasons why the second World War was lost. Most of the comments are against individuals who directed the research, selection and production of new models. You can't help but feel that Heinkel blames Germany's defeat largely on the fact that not enough of his aircraft were selected for mass production.

The end of World War II finds Heinkel in a familiar spot. As a designer and veteran of many successful models, a citizen of defeated Germany, he is again forbidden to build aircraft. 1950 finds Heinkel once more with factories and starting in industry. 1952 finds all the old associates together in the Heinkel aircraft organization, and aviation projects are being started. In putting the book down, the reader has the uneasy impression that history is about to repeat itself. Somehow, you feel that despite defeats, governmental controls, and other hindrances, another Heinkel empire is rising.

Getting the message through — 1943.

THE SIGNAL CORPS: THE EMERGENCY—Dulany Terrett (Office of the Chief of Military History, Department of the Army, Washington 25, D. C., 1956. $3.50)

"The more mobile an armed force becomes, the more rugged the terrain it encounters, or the more widely the force is deployed, the greater becomes the difficulty of securing and maintaining rapid, completely linked communications," General Orlando Ward points out in his Foreword to *The Emergency*, the first volume in the history of the Signal Corps in the Technical Services subseries and thirty-second in the series UNITED STATES ARMY IN WORLD WAR II. He describes the Signal Corps as the agency which has, as part of its mission, the responsibility of developing, procuring, and furnishing signal equipment—no mean task in an age of swift and startling progress in electronics.

The development of radar, second only to nuclear fission as the greatest scientific advance of the war, is the most important story in *The Emergency*. Here, for the first time, is given a complete account of the Signal Corps' part in the development of Army radar. The volume also covers the development of frequency modulation and describes how, thanks to the Signal Corps, the U. S. armored force was the first to have FM, which all but revolutionized the use of tanks in World War II. The advance of crystal control is an episode linked with the FM story.

The close relationship between the communications industry and the Signal Corps in the manufacturing of equipment and in the selection and training of officers and signalmen is described, as well as the wider but

very much weaker relationship between the United States and its allies, especially the British. In connection with the latter, the mission of Sir Henry Tizard and other electronic scientists and physicists to the United States in 1940 is covered.

Part One of *The Emergency* narrates the history of the Signal Corps from its earliest days up to World War II. It describes the Corps in World War I, postwar curtailment and peacetime procurement planning, the scope of the Signal Corps during this period, and early research in wire, radio, and radar. Part Two continues the story up to the eve of Pearl Harbor and covers the rapid expansion of the Signal Corps during the Limited and Unlimited Emergencies. The remarkable developments in the electronics field are described, as are the various Services—Pigeon, Photographic, Tactical and Administrative, and Supply—of the Corps.

SAMURAI!—Saburo Sakai (E. P. Dutton & Co., Inc., 300 Fourth Avenue, New York 10, N. Y., 1957. $4.95)

Reviewed by
CWO Harry M. Fletcher
Transportation Aircraft Test and Support Activity

Japan's greatest living fighter-pilot Ace of World War II relives his combat days via the pen.

Many who fought him in the grim skies of the South Pacific, and lived, will be startled to realize that an enemy's thoughts were similar to their own in the moments of combat.

Saburo Sakai reveals to all that an enemy is human, too. His personal life, thoughts, and feelings were much the same as those whom he fought against, both in the skies and on the ground. The remembrances of home, the family, and the girls left behind are in contrast to the other qualities displayed by this dedicated fighter-pilot.

The sequences of this saga are factually correct, although some of the participants in the aerial duels may disagree. This book, like other memoirs, appeals only to a certain reader class, in this case members of the aviation fraternity.

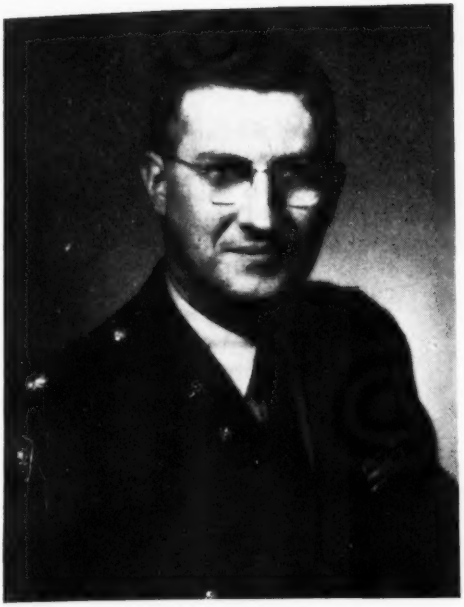
Indian Names for Army Aircraft

"Two Chickasaw, one Choctaw, and a Mojave on downwind; a Seminole on long final" may be what you'll be hearing soon now that the U. S. Army has selected the broad field of Indian tribes and chiefs to designate its aircraft.

Translated, the opening sentence merely means that two H-19s, one H-34 and an H-37 are on downwind while an L-23 is on long final. The complete list of names for current aircraft is as follows:

Sioux	H-13	Choctaw	H-34
Chickasaw	H-19	Mojave	H-37
Cayuse	H-21	Iroquois	YH-41
Raven	H-23	Seminole	L-23

Although no type or model designations have been assigned to these developmental aircraft, the deHavilland DHC-4 will be called the Caribou. and the Hiller Flying Platform will be known as the Pawnee. The L-19 Bird Dog, the L-20 Beaver and U-1 Otter will not be renamed since their present titles are considered satisfactory.



The Gray Hair Department

THE ENTIRE GRAY HAIR DEPARTMENT in this issue is devoted to one accident. The accident involves helicopter flight in low visibility and instrument conditions. Since helicopter instrument flying is a fairly new subject, it is hoped that valuable lessons in the limitations and capabilities of helicopter instrument flight can be learned from a thorough analysis and study of this accident.

A Transportation Company (Lt Hcptr) located on a tactical field near Rohrbach, Germany, prepared to return to its home station, Ober Schleissheim. Fifteen helicopters (H-34), composed of three flights, were involved in the air movement. The designated route from Rohrbach to Ober Schleissheim was from Rohrbach, north to Illesheim, east to Nurnberg, and south to Ober Schleissheim. En route and destination weather could not be determined through the use of organic communications. Therefore, the company commander

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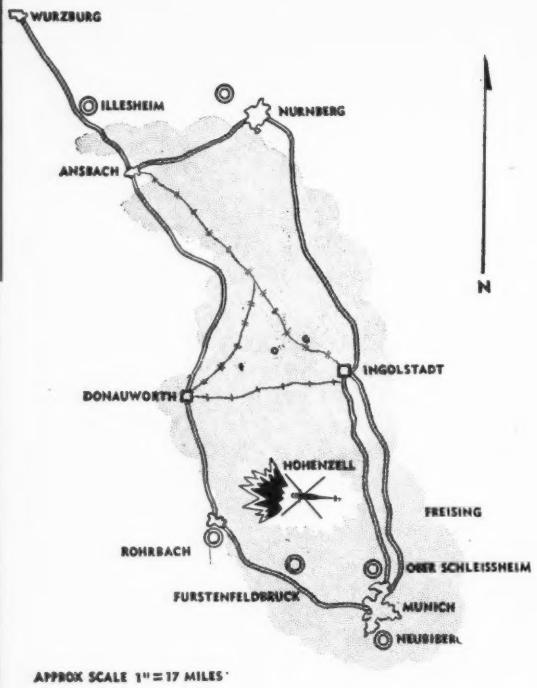
Lieutenant Colonel Delbert L. Bristol, the Senior Army Aviator pictured above, is the Chief, Airborne and Army Aviation Branch, Aircraft and Electronics Division, Office, Chief of Research and Development, Department of the Army. He attended the Field Artillery Pilot-Mechanic Course #1 at Fort Sill, Okla., in 1942 and was a member of the first contingent of Army Aviators to go overseas, reaching England in October, 1942.

He served as S3 of the II Corps and Fifth Army Air OP School in England and North Africa until March, 1943. Later he became Artillery Air Officer of II Corps in Tunisia and Sicily. From September, 1943, until his return to the U. S. in May, 1946, he was Air Officer for First Army, serving in England, France, Belgium, Germany and the Philippines. He participated in seven campaigns,



departed Rohrbach before the other flights and requested en route weather from Air Force stations in the vicinity of Illesheim. Unfortunately, he was unable to obtain the desired weather reports while airborne.

The company commander landed at Illesheim with the intention of contacting Ober Schleissheim by telephone and requesting the weather information.

Meanwhile, the first flight, consisting of five helicopters, had departed Rohrbach and had arrived over Illesheim. They were informed by the company commander that they should proceed and report enroute weather. The company commander, unable to complete the call to Ober Schleissheim, decided to depart Illesheim and contact Nurnberg and possibly obtain the en route weather. Nurnberg gave a "very general" weather report which did not contain destination weather. However, it was somehow interpreted as being destination weather. By this time the first flight was well on its way to Ober Schleissheim and landed there at 1730 without incident.

The second flight, consisting of four helicopters, departed Rohrbach at 1515, which was 15 minutes after the first flight. No formal briefing was given to the aviators. The flight was led by a warrant officer instructor pilot, while the officer-in-charge "brought up the rear." Prior to reaching Illesheim, the flight was informed by the company commander that the weather was VFR en route and that they were to continue, exercising caution.

Approximately 10 to 15 miles

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including the invasion landings of Sicily and Normandy.

Post war assignments included First Army Light Aviation Officer, instructor in the Gunnery Department of The Artillery School and a tour in Washington, D. C., as an Aviation Staff Officer. In 1952, Colonel Bristol became assistant to the Deputy Chief of Staff for Plans and Operations at Hqs, Allied Forces Southern Europe (NATO). From 1955 until his present assignment last year, he commanded the 534 Armored Field Artillery at Fort Sill.

Colonel Bristol graduated from Helicopter School in 1947, the Artillery Officers' Advanced Course in 1948 and the Command and General Staff College in 1953. He has logged more than 2000 hours during his Army Aviation career. Decorations include the Legion of Merit, Bronze Star, and Air Medal.

south of Illesheim, the flight encountered an area of extremely low visibility in the nature of a heavy fog bank. The flight flew into the fog and all helicopters executed "turns" to get out of it. Two helicopters skirted the area to the west and finally landed VFR at Ober Schleissheim. A third evaded the fog in the same manner, but missed the field at Ober Schleissheim, climbed on top and effected a GCA landing at Neubiberg AFB. The lead helicopter broke out of the fog, turned towards a valley to the east, again encountered zero visibility and finally climbed on top before making a GCA landing at Neubiberg AFB.

The third flight, composed of five helicopters, departed Rohrbach at 1530, which was 15 minutes after the second flight. The aviators had been briefed on weather, routes, and communications by the flight leader. The route from Rohrbach to Illesheim was uneventful. Near Illesheim, a weather report was received from the company commander stating that the ceiling at Munich was "1,000 or 1,500 feet, broken, with one to one and a half miles visibility."

The flight turned south towards Ober Schleissheim and encountered rapidly deteriorating weather conditions which forced the helicopters to fly at an altitude of between 100 and 200 feet with less than a mile visibility. After leaving Ansbach, the flight leader followed the railroad tracks which led to Donauworth, instead of those to Ingolstadt as he intended. He recognized his mistake, but chose to continue on and turn east at Donauworth towards Ingolstadt and follow the autobahn to Munich. Shortly after leaving Donauworth, a large airstrip was passed and identified. The flight leader was using his landing light intermittently to check his altitude above the hills. At this point the flight leader utilized the loop antenna, identified the "null" of the Freising Radio Range and turned right on a direct cross-country course to the range station.

The flight leader switched from inter-aircraft radio channel to the Ober Schleissheim tower channel and attempted to contact the tower. No contact was established. Shortly thereafter, he warned the flight to stand by for a 180° turn. The transmission was not received by any helicopter in the flight. The flight leader was then observed by number two and three to execute a sharp climbing turn to the right and completely disappear in the overcast.

Number two and three followed their leader into the overcast. Number four and five did not see the turn, but continued on and also flew into instrument conditions. The flight leader and number three, though separated, continued their turn on instruments and, after several minutes, broke out over a village identified as Schrobenhausen, where they landed and remained for the rest of the night. The number two

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The Gray Hair Department is prepared by the U. S. ARMY AVIATION DIGEST staff with information obtained from the files of the U. S. Army Aviation Safety Board. Views expressed in this department are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor

helicopter straightened out and continued to climb ahead through the overcast. It broke out on top at 3,500 feet and made a GCA landing at Neubiberg AFB. The fourth aircraft also climbed through the overcast and made a GCA landing at Furstenfeldbruck AFB.

The fifth aircraft continued on through the fog bank and, breaking into somewhat better visibility, landed to verify the position. Their position was 12 miles north-northwest of Ober Schleissheim. The instructor pilot decided to take off, and almost immediately again encountered instrument conditions which prevented all ground reference except occasional glimpses of lights. All attempts to establish radio contact with Air Force stations were futile. After circling aimlessly on instruments for some 20 to 30 minutes, the pilot decided to attempt an approach to a light he saw on the ground. The instructor pilot was apparently unaware of this decision, as he told the pilot to make a zero air speed vertical descent.

Immediately thereafter, the helicopter struck the ground in a normal descending flight attitude. The right main gear touched first, the left wheel touched briefly, and after 30 yards of roll, struck a shoulder of a road elevated about one foot above the surrounding fields. The gasoline tanks ruptured and the left main gear partially sheared as the helicopter bounced back into the air. At this point the helicopter entered a 90-degree bank to the left and struck the earth with the tips of the rotor blades. After traveling some 200 yards, the helicopter struck the ground again and started tumbling and disintegrating. Its final resting place was approximately 265 yards from the point of initial touchdown.

Investigators found that a contributing factor in the accident was an error in judgment in that the instructor pilot allowed the pilot to make an approach when the altitude above the ground could not be determined by visual reference.

The discussion which follows is intended to point the direction which appears from this incident to be the one which the Army should follow in drawing up regulations for helicopter instrument flight.

What must be done to prevent the recurrence of the type of

Wreckage of H-34 lies scattered in field.

accident discussed? What, then, must be accomplished to enhance the capability of helicopter instrument flight? The answer or safe solution to the first question must not be predicated upon a "regulation" which would in effect restrict the capability of the helicopter, but may well be contained in an adequate solution to the second.

It is noted, in the accident discussed, that the aviators of four helicopters went on instruments and successfully made GCA landings. Undeniably, this fact merits praise for the competency of the pilots concerned. The aviators of one helicopter experienced a tragic ending by trying to mingle *VFR* and *IFR* procedure. The aviators of two helicopters executed 180° turns, landed VFR in a clear area, where they remained for the rest of the night. The aviators of eight of the helicopters were able to land under VFR conditions at their destination.

Were the personnel involved in the successful GCA landings experienced fixed- or rotary-wing instrument aviators? Their flight records prove they were not. What was the instrument proficiency of these individuals? They had received, on an average, only 18 hours of hooded instrument time, all of which had been in Europe. The U. S. Army Aviation School, prior to the accident, had sent a rotary-wing instrument pilot to the European theater to help set up an instrument familiarization program. The unit to which these pilots were attached had such a program.

The requirement now looms large in front of us that helicopter instrument training must become a vital part of aviation school and unit training. Prior to graduation from cargo helicopter transition training, the student aviator should be required to perform, as a part of his final check, a simulated instrument takeoff, range orientation and a GCA controlled landing. Upon assignment to a unit, the newly designated Army Aviator, as well as those much more experienced, must be provided the opportunity to undergo a continuous instrument training program.

Instrument flight rules, as they have been drawn up and generally agreed to by all agencies, are based upon the characteristics of fixed-wing aircraft. After the fixed-wing aircraft becomes airborne, it must maintain high speed flight until it touches down upon the prepared runway at the end of the flight. Its speed makes clearance above the terrain of at least 1,000 feet (2,000 feet over mountains) vital for safety. This clearance applies only to flights on instruments or on instrument flight plans.

For visual flight, the general rule is 500 feet above the terrain and 500 feet below the clouds. This rule is modified under certain conditions. Naturally, the instrument flight rules were drawn up for nontactical flight. Even for tactical instrument flight, however, there could not be much shaving of these minimums for fixed-wing aircraft with present instruments. For helicopter instrument flight, the same rules are generally applicable. However, the innate capabilities of the helicopter establishes the reali-

zation that minimums (VFR and IFR) may be lowered to the point where the margin of safety for helicopter flight will be no less than that provided for by current regulations for fixed-wing aircraft. In other words, minimums may be lowered but not to the extent that would establish a high order of probability for an increase in the accident rate.

VFR MINIMUMS

Helicopters may be flown at or below 700 feet above the surface when the flight visibility is one-half mile or more if operated at a reduced speed which will give the pilot adequate opportunity to see other air traffic or any obstructions in time to avoid hazard of collision.

IFR MINIMUMS

A thorough evaluation of the feasibility of helicopter instrument flight has been conducted by the Department of Rotary Wing Training, United States Army Aviation School. Numerous actual instrument flights, both on and off civil airways, have been flown in varying conditions of turbulence, ceiling, and visibility, with no major problems encountered. Without exception the results obtained were excellent.

Satisfactory instrument takeoffs and ground controlled approaches have been conducted in ceilings of 50 feet and visibility of one-sixteenth mile utilizing standard equipment. The feasibility of complete "zero-zero" condition flight would be increased by the installation of an absolute altimeter and other modifications to standard instrumentation as necessary to allow the pilot to take maximum advantage of the slow forward speed capability of the helicopter during approaches.

In view of the success of this program recommended changes to Army Flight Regulations are forthcoming, and will prescribe instrument approach minimums for the holder of the proposed Army Rotary Wing Standard Instrument Certificate to be 100 feet below the fixed-wing minimum ceiling published in TM 11-2557. Recommended takeoff and ground controlled approach minimums will be 100 feet and one-fourth mile visibility.

For the holder of the proposed Army Rotary Wing Special Instrument Certificate, no minimums will apply. Clearance will depend on the judgment of the pilot, and it is expected that pilots will use this prerogative conservatively and will carefully consider all factors in determining that the particular flight is within their capabilities.

All-weather, "around the clock" helicopter operation is considered essential to the efficient employment of Army Aviation in the combat zone. Accidents such as the one described in this article clearly indicate the requirement for a rotary-wing instrument training program.